INDUSTRIAL HYGIENE SECTION

This Industrial Hygiene Section is published to promote sound thought upon and concerning industrial hygiene. To that end it will contain articles, discussions, news items, reports, digests, and other presentations, together with editorial comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

Reg. U. S. Pat. Off.

The Editorial Committee will exercise its best judgment in selecting for publication the material which presents most exactly the factors affecting industrial health and developments for control of potentially injurious exposures. The editors may not concur in opinions expressed by the authors but will endeavor to assure authenticity of fact.

The Science, the Law and the Economics of Industrial Health

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Post-War Industrial Hygiene

ESSENTIALS only are the order of the day as manpower and material shortages become increasingly critical. Among the services which have stood the test of essentiality is industrial hygiene. We refer not to the static condition of good plant sanitation, desirable as this is, but to the dynamic procedure of close control of industrial health hazards through well trained industrial hygiene personnel: the noting of potentially hazardous materials and operations; the evaluation of their relative severity through determination of the extent of exposure, using chemical, physical and physiological test methods; the instigation of control measures where necessary; the positive check on adequacy of such methods; the establishment of reliable toxic limits of injurious materials through correlation of exposure with physiological response.

Such industrial hygiene services are being provided at this time by Federal, state and municipal bureaus, and through insurance companies, manufacturing and mining concerns, organizations, universities and private consultants. But what of industrial hygiene after the war? Will the change from present manpower shortage to an abundance of eager job seekers result in a lessened interest in industrial hygiene?

It is our belief that the fundamental advantages of industrial hygiene both to management and labor have been so sufficiently demonstrated that it will continue to progress during and after the transition period following the war.

There will be the demands of labor that working environment be such as to cause no injury to health. To these will be added the insistence of the government that our adult manhood be maintained at a better health level than that disclosed through physical examinations under the Selective Service System. Intelligent managements will see to it that their workers are kept alert physically and mentally even though potentially injurious materials or processes are to be utilized.

Wth the more extensive use of such materials and processes throughout industry, there will be increasing need for industrial hygiene services at present available. In addition, a greater number of the larger industrial concerns will find that industrial hygiene divisions within their own organizations pay real dividends. Occupational diseases can be markedly reduced and under most circumstances entirely eliminated. Production is advanced where health of workers is not impaired. Industrial relations are furthered when workers have real evidence that management is providing working conditions which are favorable rather than detrimental to their health.

Just what development of industrial hygiene activities will the manufacturer find best adapted to his operations?

In the larger industrial organization, perhaps with multiple plants, there should be a headquarters laboratory specially set up for occupational disease control with a well trained industrial hygienist having chemical or chemical engineering background. This industrial hygienist should have not only broad experience in manufacturing operations which present health hazards and the control of them but also the type of personality which will permit him to work well with plant superintendents and personnel, medical and safety departments.

The nucleus of the industrial hygiene division should also include a chemist to conduct the greater part of the laboratory determinations, many of which involve methods for which the plant control laboratory is not ordinarily available either in apparatus or in techniques.

These larger concerns may well consult existing industrial hygiene services such as those in the state departments, insurance carriers or private organizations such as the Industrial Hygiene Foundation of

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America in making their plans for incorporating a division to handle this subject in their plants. A number of industrial concerns which have already been operating such divisions over the past several years will have much assistance to offer based on actual experience.

Where smaller manufacturing concerns are confronted with occupational disease exposures, they may maintain closer control over the exposures by assigning responsibility to some appropriate person in the plant. Whether that person should be the safety engineer, the plant nurse, the chemist or the plant engineer depends upon local conditions. Here again the industrial hygiene services can be of much guidance in laying out the problem and a procedure for positive control.

With industrial hygiene services available today, there need be no appreciable incidence of occupational diseases even in the most hazardous of operations—with the exception of industrial dermatoses, which will continue to occur. In order to assure the virtual elimination of the occupational diseases, it will be necessary to extend the application of present industrial hygiene methods so that injurious exposures are avoided or brought under control before actual injury to health occurs.

In looking forward to post-war industrial hygiene, there will undoubtedly be a broadening of scope to include correction of so-called nuisance conditions caused by obnoxious but non-toxic dusts, gases and odors. The industrialist of tomorrow will pay more attention to the provision of favorable working conditions both as these favor profitable operation and as labor and government exert greater influence for such an environment. It is not to be inferred that an Utopian condition will come out of the war. Economics, idiosyncrasies of human nature, failures to anticipate situations will all be factors which will continue to introduce problems for the industrial hygienist to contend with. We believe, however, that there will be a wider recognition of the desirability of improved occupational environment and of the essentiality of industrial hygiene divisions having well trained and experienced personnel, equipped with the necessary field and laboratory apparatus to be charged with the responsibility of maintenance of good industrial hygiene.

Chlorinated Solvent Exposures

—At Degreasing Operations—

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SATISFACTORY coating of metal depends, among other factors, upon the degree of cleanliness of the object at the time of coating. To meet the requirement of a fast efficient method to remove grease, oil and dirt, chlorinated solvent degreasing was developed. Degreasing units generally employ trichlorethylene as a solvent under numerous trade names, such as permachlor, triad, blacosolv, and tromex, but in 1939 degreasing units employing perchlorethylene (tetrachlorethylene), under the trade name of Phillsolv, appeared on the market.

The health hazard associated with chlorinated solvent degreasing has been a problem of much debate. While it is generally accepted that these chlorinated solvents are toxic if inhaled in sufficient concentrations over extended periods of time, the problem in the field has received little study. The mere fact that a material is toxic does not necessarily imply that a hazard develops with its use. It is only through detailed field study under its actual use that the health hazards inherent in its application can be deduced. Laboratory researches, under controlled conditions, while highly desirable, can not be assumed to provide the solution. Theory and practice vary considerably in most cases, but both supply essential data. It is hoped that this study will provide part of the necessary field studies for determining the health problems associated with chlorinated solvent degreasing in the available marketed units.

Scope of Study

THE Division of Industrial Hygiene of the Illinois State Department of Public Health undertook this study of degreasing machines during 1942, with the major part of the work conducted during the last half of that year. The general scope of the study was as follows:

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Number of Plants	60
Number of Machines	108
Ventilated condensing	39
Non-ventilated condensing	58
Enclosed, automatic	7
Non-condensing	11
Number of atmospheric vapor determinations	433

All machines were units employed in industry and the atmospheric samples were made during normal degreasing operations.

The trichlorethylene solvents encountered in these degreasing units were perm-a-clor, triad, blacosolv and tromex, while phillsolv[1] was the only perchlorethylene solvent in use. The chief difference in these trichlorethylene solvents is in the degree of stabilization. Today, they are stabilized to different degrees and marketed under certain trade names to meet the different requirements of industry. Chlorinated solvents, without stabilization, will break down, liberating free corrosive hydrochloric acid through three fundamental causes: presence of air (oxidation); presence of water (hydrolysis); and high temperature (pyrolysis). While oxidation inhibitors are available for stabilization, one manufacturer of chlorinated solvents[2] states that no successful inhibitors of either pyrolysis or hydrolysis are known. Stabilization, however, has nothing to do with specific toxicity of the solvent.

Table 1 reveals some of the physical properties of trichlorethylene and perchlorethylene.

Of particular interest are the vapor pressures and vapor densities of these solvents. The relative evaporation rates of these two solvents is about 3 to 1, with

TABLE 1.
PHYSICAL PROPERTIES OF CHLORINATED SOLVENTS

Solvent	Trichlorethylene C_2HCl_3	Perchlorethylene C_2Cl_4
Boiling Point—° F.	188.1	249.4
Latent Heat of Vaporization (Btu./lb.)	103.1	90.1
Vapor Density (Sp. Gr. Air = 1.0)	4.5	5.7
Vapor Pressure (@ 30° C)	91.0	28.0
Sp. Gr. 20°/4° C.	1.46	1.62
Molecular Weight	131.38	165.83

perchlorethylene having the slower evaporation rate. While such physical constants are of interest, they are not indicative of the relative atmospheric vapor concentrations, since it is the vapor which is the chief degreasing medium. These constants would be of more importance if these solvents were used cold. We are not qualified to judge the merits of both solvents for degreasing. On the basis of the physical properties alone, particularly the boiling point and latent heat of vaporization, it appears that perchlorethylene, if it is satisfactorily stabilized, is favored. However, this conclusion is based upon its use in a condensing type of machine. Its use today is not in machines with condensers. This does not imply that equally as good degreasing can not be accomplished with trichlorethylene.

Toxicology

THE opinions of medical authorities in regard to chronic or acute poisoning from trichlorethylene or perchlorethylene are by no means unified. Nevertheless, both solvents are regarded as toxic. There is only one published medical research study in this country with which we are familiar. Nor were we acquainted with any more than two cases of solvent poisoning from machine degreasing that were compensated by the industrial commissions of the various states up to this year. However, in the early part of this year, the New York State Department of Labor reported that two fatalities of persons employed at degreasing operations in which trichlorethylene was the degreasing agent, had come to the attention of their Division of Industrial Hygene. It is significant that most of the deaths in European literature were preceded by symptoms of narcosis, but these two cases had very little, if any, narcosis.

In England and Germany, where trichlorethylene degreasing has been employed much earlier than in this country, many deaths have been reported.[3] This may have been due to inferior degreasing equipment. On the other hand, the workmen's compensation system in England and Germany has been more efficient than that in this country.

It has always been a matter of wonder to us that, with so much industrial medical research being conducted and with solvent degreasing a major industrial process, toxicological studies have not been undertaken on degreasing solvents. The only medical research study on these solvents, and which was previously referred to, was conducted by Carpenter[4] at the University of Pennsylvania and reported in 1937. This work was done on perchlorethylene, which is used today in only one type of degreasing unit and is sold for this unit, under the trade name of phillsolv. This investigation by no means clarified the toxicity of perchlorethylene. It stated that 50 parts per million produced a definite odor and concluded that a concentration somewhere between 100-500 p.p.m. is considered safe for daily exposures not in excess of 40 hours per week. This range of 100-500 p.p.m. is in need of extensive study.

Many of the states have accepted 200 p.p.m. (parts per million parts of air) as the maximum safe concentration for continuous exposure to trichlorethylene or perchlorethylene. This limit has not been based upon toxicological data from field investigations or on the results of practical or economical ventilation measures. It is primarily based upon the opinions of European industrial medical authorities. It is not clear whether this safe limit is based upon the maxmum concentration that will prevent acute poisoning or whether the strong narcotic effect of these solvents has been considered. It is claimed that both solvents have marked anesthetic properties, and we know that trichlorethylene recently has been proposed for use in anesthesia. We have found complaints of headache, nausea, and dizziness quite common among degreaser operators when atmospheric solvent vapor concentrations were well within the generally accepted toxic limit. It does appear to us that a worker complaining of these upsets presents a physiological manifestation as truly occupational as those which might arise from an exposure to a higher concentration. It does seem, therefore, that safe maximum concentrations, or what are known as toxic limits, should be based upon this premise, particularly when such lower concentrations are easily attainable by practical and economical engineering measures and operating procedures. We, therefore, feel that in the case of trichlorethylene and perchlorethylene, the safe maximum concentration for continuous exposure is too high. Since atmospheric solvent exposures of 100 p.p.m. at machine degreasing operations with the condensing type of unit can be easily obtained by good machine operation and location, with or without local exhaust ventilation, and since exposures much in excess of this figure elicit frequent complaints among degreaser operators, it is felt that the toxic limit should be set at a concentration considerably below the 200 p.p.m. limit in order that due respect be given to the anesthetic properties of these solvents.

Little clinical information is available in this country or in European medical experience to indicate the preference of trichlorethylene over perchlorethylene, or vice versa. Both are reported to have considerable narcotic action.

Sampling and Chemical Procedures

IN ANY study of atmospheric contamination, the device for obtaining the air samples and the chemical analytic methods play no small part. In the past 10 years, a good deal has been accomplished in the field of micro-chemical methods and procedures.

Methods for determining atmospheric solvent concentrations have, in the past, depended upon the interferometer or the Willson apparatus. The interferometer lacks most of the essentials of a good field instrument and has an accuracy of only ±20 p.p.m. The Willson apparatus, while a more efficient instrument, lacks good portability. Both instruments could not be easily moved about as the worker changed his positions, which must be done if an accurate measure of the worker's exposure is to be obtained. These instruments are, therefore, limited to measuring areal contamination which, although important, is not a measure of the worker's exposure. The average time spent in each area must be integrated if the average exposure, which is the desired result, is to be determined. This is automatically done with a portable instrument, for the worker can be followed about durng the sampling interval.

In this study, we were fortunate in the fact that our laboratory developed such an instrument[5] with supplementary analytic procedure. This instrument, shown in Fig. 1, which we call a micro-furnace, is somewhat similar in principle to the Willson apparatus, but is extremely portable. As a matter of interest, the Willson apparatus weighs approximately 23 pounds and our instrument weighs only 1.5 pounds. This instrument is based upon the fact that chlorinated hydrocarbon vapors, when passed over heated platinum and subsequently passed through a reducing medium, will produce an amount of HCl equivalent to the chlorine present in the chlorinated compound. If the absorption medium (sodium arsenite) is a liquid of definite volume and having a definite alkalinity, the amount of HCl obtained during sampling may be determined by

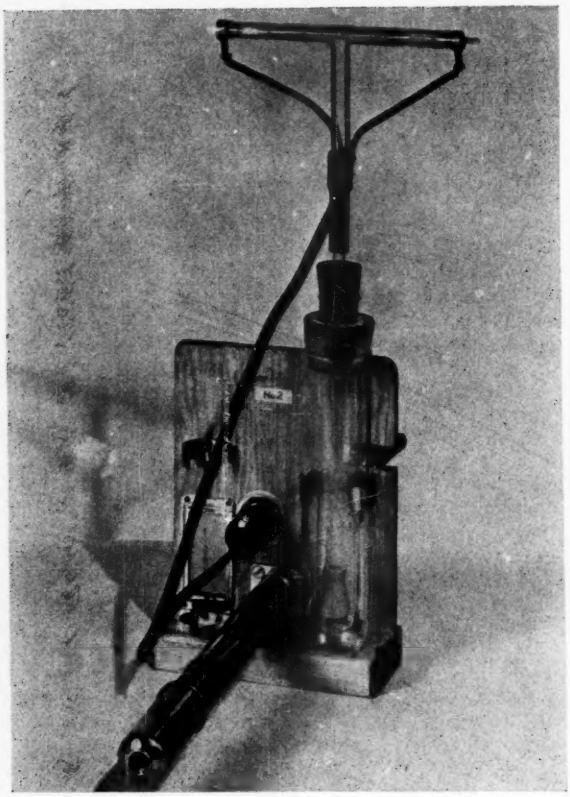

Fig. 1.

direct titration with HCl to a neutral point. This sampling and analytical method is accurate to within ±2%.

Degreasing Theory

THE most common degreasing equipment in its simplest form consists of a metal tank equipped with a heating element at the bottom for heating the solvent, and a water condenser of the jacket or coil type to condense the vapor. The solvent used in this type of degreaser is trichlorethylene. Recently a degreaser was placed upon the market which excluded the water jacket and relied upon a bimetallic thermostat for vapor control. This machine employs perchlorethylene. These machines may employ liquid solvent for immersion or for spray, since the simple vapor phase alone is limited to about 10% of the degreasing applications.

In vapor degreasing, the cold metal is slowly lowered into the vapor at which point the vapor will condense on the metal until the work is heated to the boiling point of the solvent. The solvent dissolves the oil and grease, and cleaning is accomplished by a washing effect. This washing effect greatly decreases as the temperature of the metal approaches that of the vapor, thus an advantage for the solvent with the higher boiling point. This vapor method has these disadvantages: it will only remove soluble material; on light gauge metal, the rapid heating prevents uniform condensation all over the work and results in oil runs and stains; and finally, irregular shaped work has a tendency to trap the oil and solvent, as well as to contain air pockets which exclude the vapors. To overcome these disadvantages, the immersion and spray type of degreaser were developed. These have the advantage of providing a mechanical cleaning, produced by the roll of the solvent over the surface of the work. The machines generally found contain two or more of these phases, i.e., vapor, immersion, spray. The usual sequence of operation is immersion into boiling solvent to remove heavy dirt and grease, immersion into cold solvent to rinse and cool the metal, and finally suspension in the vapor for a pure vapor rinse. When the spray is provided, the immersion phase is generally omitted.

It is claimed that degreasing machines are designed on a careful thermal balance between the heat supplied, to keep the solvent boiling as the work passes through the tank, and sufficient cooling in the condensing zone to maintain a definite maximum vapor level at all times, including the period of maximum heat input. In other words, the machine is designed to have a heat input great enough so that the vapor height will not rise and fall in the tank as the work is put in and taken out. There is no reason to doubt this claim. However, few machines are found which are operated under designed conditions, and, as the result, the vapor height does change and changes radically, in many cases, as work is introduced. This results in air entering the tank as the vapor height falls with the introduction of work, becomes contaminated with vapor and is expelled from the tank as the vapor height rises after the work is removed or while the work is in the tank.

Not only is it essential to maintain the thermal balance, but the dew point level is also important. The coolest point in the condensing zone should not fall below the dew point temperature of the room air in order to prevent the condensation of the moisture in the air. This moisture is detrimental to tank operation, for it lowers the boiling point of the solvent causing excessive solvent losses and increases the fusibility of the vapor.

Most of the degreasing machines in operation are manually operated, and it is in this condition that one of the chief causes can be found for high atmospheric solvent concentrations. Ideal control of solvent exposures rests upon divorcing all operating factors and control measures from the human factor. To this end, more can be accomplished by degreasing machine manufacturers than is at present provided. The wider use of thermostatic devices for controlling the heat balance (vapor height, solvent temperature and condenser water), and providing mechanical hoists as an integral part to all machines is a responsibility of the manufacturers to the safe use of their products. The great advantage to be gained by a mechanical hoist will be shown later in this paper.

Atmospheric Findings

THE average exposure during degreasing operations was obtained by 379 atmospheric samples at 108 machines which included the condensing type of machines, with and without local exhaust ventilation, and the non-condensing machine which had no local exhaust ventilation. These averages are shown in Table 2.

TABLE 2.
GENERAL AVERAGES

Type of Machine	Number of Machines	Number of Samples	Range of Atmospheric Findings (ppm)	General Average (ppm)
Condenser—Ventilated	39	149	5-393	96
Condenser—Non-ventilated	58	187	3-900	135
Non-Condenser	11	66	24-880	221

It can be seen that there is a marked difference in the average exposures at the ventilated and non-ventilated condensing type of degreaser. The ranges of atmospheric findings between both types are also much greater in the case of the non-ventilated machine. The

non-condenser type of degreaser, which type employs perchlorethylene, has the highest general average of the three groups. However, since only eleven of these machines were found in use, and only 66 atmospheric determinations were made, the statistical adequacy of the data for this type of degreaser can be questioned. Nevertheless, after viewing the operating principles of these machines, higher findings were expected. Solvent vapor was seen overflowing the top of the tank in one or two cases due to poor or impaired action of the vapor thermostat which is the only means of controlling the vapor height. This condition was not seen in the condensing type, although in a few cases the condensing jacket water was not circulating. It is felt that bimetallic thermostats are not quick enough in action to warrant their use as the sole means of vapor control.

TABLE 3.
RANGE OF ATMOSPHERIC CONCENTRATIONS

Range of Concentration (ppm)	All Tanks		Ventilated Tanks		Non-Ventilated Tanks		Non-Condensing Tanks	
	No.	%	No.	%	No.	%	No.	%
0— 50	109	27.1	69	46.9	29	15.4	11	16.9
51—100	97	24.2	29	19.7	58	30.8	10	15.1
101—150	68	16.9	15	10.2	47	24.8	6	9.0
151—200	36	9.0	10	6.8	17	8.9	9	13.8
201—300	59	14.7	20	13.6	25	13.2	14	21.2
301—400	19	4.7	4	2.8	7	3.8	8	12.1
401—500	5	1.3			2	1.0	3	4.5
501—600	3	0.7			1	0.5	2	3.0
601—700	2	0.5			0	—	2	3.0
701—800	1	0.2			1	0.5	0	—
801—900	3	0.7			2	1.1	1	1.4
Totals	402	100.0	147	100.0	189	100.0	66	100.0
%	100		36.6		47.0		16.4	

Table 3 indicates the distribution of atmospheric findings. It is important to note that 51.3% of all samples were 100 p.p.m. or less and that 77.2% of all samples were 200 p.p.m. or less. Interpreting the data by tank category, reveals that 66.6% of the samples at the ventilated condensing tanks; 46.2% at the non-ventilated condensing tank; and 32.0% at the non-condensing tanks were 100 p.p.m. or less. The percentages of samples 200 p.p.m. or less were 83.6%, 79.9% and 54.8% respectively. The importance of local exhaust ventilation in maintaining concentrations below 100 p.p.m., in the case of the condensing machines, is not impressive. Ventilation, as will be later shown, is not the cure-all for all operating sins.

Operating Factors

PROBABLY no single operating factor is more important in maintaining low solvent exposures than the speed at which the work is lowered into and removed out of the machine. It has been recommended by the equipment manufacturers that this speed be no greater than 12 feet per minute. Only 20% of the machines, and this included six automatic machines, were correctly operated. Table 4 reveals the percent of the total number of machines in each range of operating speed. Speeds as high as 120 feet per minute were found.

Degreaser operators generally lower the work into the machine at a much faster rate than they withdraw it. This resulted, in several instances, in the non-condensing machines, in causing the vapor to overflow the top of the tank. Supervisory personnel is extremely lax in impressing the importance of operating speed upon operators or in enforcing good operating rates. One place for making up lost production time due to breakdowns, etc., is generally the degreasing operation. Thus the need for divorcing machine operating from the human factor as far as possible.

TABLE 4.
TANK OPERATING SPEEDS

Speed Range	Percent of Machines in Each Speed Range		
	In	Out	Average
10—12	20.1	35.6	20.0
13—20	12.2	24.4	18.9
21—40	26.6	24.4	28.8
41—60	14.4	3.3	15.5
61—80	6.6	3.3	10.0
81—100	15.6	4.5	4.4
Over 100	4.5	4.5	2.3

Table 5 is an attempt to correlate operating speeds and solvent exposures. There is some error in the determination of operating speeds due to the fact that the start and stop points had to be noted and then measured. However, it is not felt that this is a great error. The interesting finding in this table is that, in the non-ventilated condensing machines, an operating speed of 40 f.p.m.; and in the case of the ventilated condensing machines, an operating speed of 80 f.p.m. was obtained before the solvent exposure appreciably exceeded 100 p.p.m. It would be interesting to see the results of other studies of this factor. However, despite atmospheric findings, the greater the operating speed the greater the solvent loss. The fact that most of these machines were in large rooms with good general ventilation due to warm weather conditions, is believed to be a major factor in maintaining low atmospheric findings, for it supplied a large dilution factor. The findings at the perchlorethylene, or non-condensing tanks, appears to indicate an advantage of the condenser as an additional vapor control measure, although as previously mentioned, the statistical adequacy of the data at these tanks can be questioned.

If these results can be substantiated by additional studies, it does not follow that the machines should be operated at much higher rates. However, it is felt that an operating rate probably in excess of 12 f.p.m., as recommended, can be economically and safely set. It is felt that a rate at least as high as 20 f.p.m., for some work can be safely used. Work removed from the machines much faster than the manufacturers recommendation will be partially wet. This implies excessive solvent loss and cost.

The great advantage of the enclosed automatic ma-

TABLE 5.
EFFECT OF OPERATING SPEED AS TO ATMOSPHERIC CONCENTRATIONS

Average Operating Speed — FPM —	Atmospheric Vapor Concentration — PPM —		
	Non-ventilated Tanks	Ventilated Tanks	P C L Tanks
10—20	92	71	—
21—40	96	108	129
41—60	137	90	174
61—80	176	62	310
81—100	202	175	254
100—150	248	—	295

chine can be partially indicated by the findings at the six machines included in this study. The average solvent exposure at these machines was 84 p.p.m.

The data in Tables 4 and 5 demonstrate the necessity and advantage of a controlled operating speed. It is felt that this is the greatest single requirement of present degreasing machines. It appears that equipment manufacturers by selling all machines with mechanical hoists with a limited speed range, would be contributing much to the safety of degreasing and the economy of operation.

Poor Operating Factors

THERE are certain precautions that should be taken for the safe and economical operation of degreasers. By discussing the abuses of these precautions, the proper measures will be indicated. One of the major abuses found was not keeping the work in the vapor zone until condensation stops. This resulted in the removal of the work wet and often dripping, which contributed much to the atmospheric vapor concentrations. This condition is aided by overloading the machine and disrupting the heat balance. As a consequence, it requires a long time before condensation stops and the impatient worker, possibly driven by a foreman, withdraws the work dripping wet. Condensation must stop, and the work withdrawn slowly if it is to be removed fairly dry. However, workers can not be expected to move heavy baskets of work slowly through the vapor zone.

Another major abuse in operating technic was the improper arrangement of irregular shaped work in the work basket. This results in improper drainage of the condensed solvent and again the removal of wet work. Irregular shaped parts must be carefully laid in the basket to allow good drainage. If drainage is still difficult, keeping the work in the vapor after condensing has ceased may allow boiling off the retained solvent. It was also found that where draining could not be satisfactorily accomplished in the vapor zone, the solvent was not carefully drained by tilting the basket or work on the top of the tank. Impatience again resulted in removing dripping work.

One case was seen where, in order not to mar a highly polished surface, cloth rags were wrapped around the prongs of the hook used in moving the work through the tank. The result was that the rags became wetted each time when striking the vapor and as the hook was removed from the tank, the solvent readily evaporated from the rags.

Still another poor practice was that practically no positive control of the condenser water was found. Very few tanks even had a thermometer in the outlet pipe. This was the general finding despite the fact that the condenser plays a major role in the heat balance of the machine. The usual control was entirely manual operation of a hand valve in the water line. Conditions were seen where the water in the condenser was not circulating at all. One equipment manufacturer[6] recommends that the condenser must always be supplied with cool water sufficient to prevent its exit temperature from rising above approximately 110°F. A study conducted in New York[7] recommended a water inlet temperature of 70°F, and 90°F at the outlet. It would, therefore, appear that since the cooling effect of the condenser plays such an important role in the design of the machine, this role should be thermostatically controlled or at least all condensing type degreasers should have thermometers in its water inlet and outlet lines. Without sufficient control, the freeboard distance will be seriously altered and the danger of vapor flowing over the top of the tank becomes quite possible. The freeboard distance, which is that distance from the top of the tank to the top of the vapor zone, should be, at a minimum, 0.6 the width of the tank.

It is quite evident that all poor operating procedures lead to excessive solvent loss and cost. This fact alone should be of great interest to management. It was also evident in this study that degreasing tanks can not be operated by an impatient, inexperienced and not too bright worker. That such workers are found at degreasing tanks is entirely the fault of management. Generally degreasing is viewed as unskilled work to which anyone can be assigned. However, on the contrary, the work is skilled. The assignment of a careful and well trained man to degreasing, at a higher wage scale than that for unskilled work, would be economically wise, for the saving in solvent alone would pay for the increased rate.

Effect of Movement through Vapor

IT IS NOT generally understood that the exposure of the degreaser operator varies with the movement of work through the solvent vapor, for all but the enclosed automatic machines. The more continuous this movement, the more static the exposure becomes. The minimum exposure should occur when the tank is hot and no work is passing through the machine. In all types of machines a very sharp reduction in atmospheric solvent was found when the work was not moving through the vapor zone. This reduction was, in most cases, in excess of 30% for the ventilated condensing machines, about 50% for the non-ventilated condensing machine, and about 50% for the non-condensing or perchlorethylene machines. However, no comparison between the various types can be made, for the higher the exposure, the greater the reduction to be expected. Furthermore, speed of operation is a function of atmospheric contamination, and both the ventilated and non-condensing machines had high operating rates. The important point is that a great reduction in exposure occurs, which indicates the benefit of the dilution factor achieved in large normally ventilated rooms.

TABLE 6.
ATMOSPHERIC VAPOR CONCENTRATIONS AT HOT NON-OPERATING TANKS

Type	Ventilation	Ave. Vapor Concentration at Machine
		ppm
Condensing	Yes	33
Condensing	No	76
Non-Condensing	No	125

Table 6 reveals the results of a series of samples at hot machines, which had not been operated for several minutes or the heat had been turned on prior to operating. Air samples taken at distances from the tanks were rarely in excess of 25 p.p.m. at a distance of 5 feet when sharp air currents did not pass over the tanks and the rooms had good general ventilation.

Solvent Loss

SOLVENT consumption is determined by type and size of work and exposed surface area. The general opinion regarding solvent loss is that it should not exceed 0.20 gals per hour of operation or 2.5 gals. per sq. ft. of tank area per hundred hours of operation. These may be satisfactory indices of economical tank operation. However, it is not felt that solvent loss can be used as a practical index of solvent exposure for several variables, such as room size, room ventilation and tank ventilation, tend to compensate for excessive solvent loss. This is not intended to mar the importance

of solvent loss as a measure of economical tank operation, but rather to emphasize the importance of atmospheric sampling in the measurement of solvent exposure.

In this study, no accurate data could be secured on solvent losses. No plant kept records of the exact hours of tank operation or of the solvent consumed in a definite period of time. Very few tanks were operated continuously throughout the day and no plant had given much attention to economics of solvent loss. Therefore, it was necessary to secure rough estimates of foremen and other personnel. Analysis of this data revealed the average solvent losses shown in Table 7.

TABLE 7.
SOLVENT LOSS

Type of Tank	Solvent Loss	
	Gals./100 hr./sq.ft.	Gals./hr.
Ventilated Tanks	4.9	0.37
Non-Ventilated Tanks	4.2	0.37
P C L Tanks	6.0	0.40

In general, the ventilated tanks had slightly greater solvent losses than the non-ventilated condensing tanks, and the perchlorethylene machines had the greatest. All average losses exceeded the accepted indices of economical operation. This was expected because of the exceedingly poor operating practices which were generally found. The excess of solvent loss of the ventilated condensing tanks over the non-ventilated condensing tanks was also expected, since ventilation does remove some solvent vapor from the tank. Witheridge and Walworth[6] found in their work that slot ventilation increased the solvent losses 0.3 gals. per sq.ft. of tank area per 100 hours of operation when their tank was operated 20% of the time, and 1.2 gals. when operated full time.

The range of solvent losses on the basis of gallons per sq.ft. of tank area per 100 hours of operation was from 0.7 to 18.0 for the ventilated condensing tanks with a median value of 4.9 gallons. In the New York study previously mentioned, the losses for ventilated condensing tanks ranged from 0.3 to 15.0 gals. per sq.ft. of tank area per 100 hours of operation, with a median value of 3.5 gallons. No correlation could be found between our solvent loss data and the atmospheric vapor concentration.

Cleaning of Tanks

THE frequency of tank cleaning depended upon the type of work and hours of operation. In general, the tanks were cleaned weekly. Despite the fact that a very high exposure occurs in the cleaning operation, many tanks were found where no respiratory protective device was worn while doing this work. The greatest complaints came from men who had to do this work. In one war plant, a service engineer from one of the tank manufacturers was employed to maintain two large, automatic tanks. However, even this individual did not wear any respirator. A cartridge type respirator, or better still, an air line respirator, should be worn when cleaning out the tank. If a cartridge type of respirator is used, a new cartridge should be employed for each cleaning and care should be exercised to insure that the respirator is of the type used for adsorbing organic solvent vapors.

Location of Degreasers

THE importance of proper location of degreasing machines with respect to excessive air currents and good room ventilation can not be stressed too much.

TABLE 8.
LOCATION OF MACHINES BY ROOM SIZE (CAPACITY)

Room Size (Cubic Feet)	Number of Machines	% of Total
1—10,000	10	9.2
10—25,000	12	11.1
25—50,000	19	17.7
50—100,000	12	11.1
Over 100,000	55	50.9
	108	100.0

Certain precautions of machine operation and location must be adhered to, if safe and economical operation is to be attained.

In this investigation, the importance of placing degreasing machines in large rooms in order to obtain a good dilution factor was better understood than any other single good practice. Table 8 reveals that only 9.2% of the machines were located in rooms under 10,000 cubic feet in capacity and that 50.9% of the machines were in rooms of over 100,000 cubic feet.

No machines or other appurtenances were found to be located in pits or in a confined space with little air movement. Such conditions are poor and favor high solvent exposures.

Great care should be exercised to locate degreasing machines in areas free from excessive air currents. Such excessive air motion over the top of open tanks tends to drag the vapor out of the tank and contaminate the general room air. In several plants, this condition was the cause of complaints of workers 20-30 feet from the tank. Since these workers were not previously exposed to solvent vapor, their sense of smell detected very low concentrations which, although less than 50 p.p.m., were nevertheless obnoxious to them. Such excessive air currents may be produced by unit heaters, open windows, spray booths or hoods with high ventilation rates. Some of the greatest faults found were locating machines near open windows or doors through which a high ventilation rate was found, and locating degreasers under unit heaters or air inlets which did not properly diffuse the air.

Table 9 reveals the solvent exposures at some machines over which excessive air currents were found. The necessity of preventing excessive air motion over degreasing tanks is quite clear. It appeared that lateral air currents in excess of 75 f.p.m. were detrimental.

TABLE 9.
EFFECT OF AIR MOTION

Tank Number	Lateral Air Movement over Tank (fpm)	Tank Vent.	Average Atmospheric Concentration (ppm)
1	150—200	N V	182
2	125—170	N V	433
3	205	N V	260
4	155—210	V	156
5	105—125	N V	144
6	175—250	N V	225
7	110—200	N V	291
8	50—150	V	103
9	100—200	N V	351
10	100—140	N V	140
11	400—1000	N V	406
12	150—200	N V	207

Control Devices

SINCE degreasing units have a carefully designed heat balance, the necessity for controlling or regulating this balance is obvious. Tanks are generally found in use free from any thermostatic control for either the vapor height or condensing zone. Of the 108 machines in this investigation, only 39 machines (36.1%) had vapor thermostats and only 14 machines (13%) had thermostats in the boiling solvent. In no machine was any control of the condenser water seen, except manual control by regulating a hand valve. This control was decidedly inadequate.

A thermostat is necessary to prevent overheating and too rapid boiling off of the liquid solvent, thereby producing vapor more rapidly than it can be condensed. In addition, a vapor thermostat is necessary to control the vapor height in case of failure of other controls. At least a thermometer is necessary in the condenser inlet and outlet lines to insure the maintenance of proper condensing water temperatures.

Tank Ventilation

THE problem of whether or not degreasing tanks should be ventilated is one of mild controversy. It is felt that tanks carefully operated and well located will reveal solvent exposures well within 150 p.p.m. and even as low as 100 p.p.m. Such findings are well within the toxic limit, if accepted at 200 p.p.m. However, at concentrations of 100 p.p.m., some men will complain of headache, nausea and dizziness. For such individuals ventilation is necessary. In addition, very irregular shaped work may require ventilation, since vapor or solvent retention may be very difficult to entirely eliminate in a reasonable time. Tanks in small spaces, with little general ventilation, may likewise require tank ventilation. However, ventilation cannot be viewed as a compensator for poor operation and poor location. Despite ventilation, solvent exposures above 200 p.p.m. were found in this study.

It has been recommended in the New York study previously mentioned[7] that where exhaust ventilation is necessary, it should be supplied at a rate of 60 c.f.m. per foot of tank perimeter through a 1½ inch horizontal slot. The recommended slot velocity was 500 f.p.m. Witheridge and Walworth,[8] however, found that a ventilation rate of approximately 30 c.f.m. per square foot of tank area with a slot velocity of approximately 350 f.p.m. was sufficient to reduce the solvent exposure in the operator's breathing zone from 400 p.p.m. to 100 p.p.m. In this study, 32 tanks (30.0%) were ventilated and only eight of these tanks had a ventilation rate equal to or greater than 60 c.f.m. per foot of tank perimeter. The average ventilation rate was 40 c.f.m. per foot of tank perimeter. The average exposure of these eight tanks was 105 p.p.m. against a general average for all ventilated tanks of 96 p.p.m. The most common hood arrangement was one-inch horizontal slots extending along the long sides of the tank.

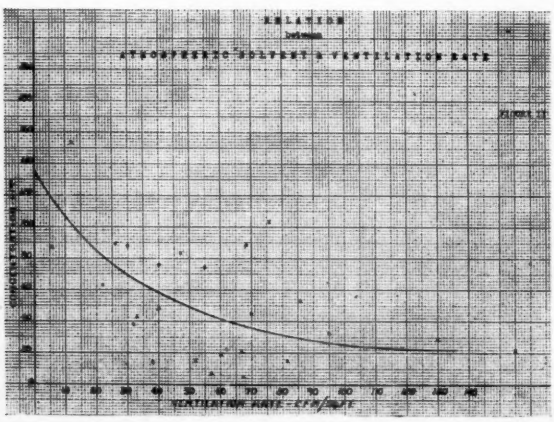

Fig. 2.

We have felt that the ventilation standards at all tanks should be based upon tank area. Therefore, an attempt was made to correlate solvent exposures against such ventilation rates found at the tanks. Fig. 2 reveals the result of this correlation. It is interesting to note that 30 c.f.m. per square foot of tank area was found, on the average, to be sufficient to produce an average solvent exposure of approximately 70 p.p.m., and approximately 15 c.f.m. per square foot of tank area was sufficient to provide an average exposure of 100 p.p.m. We, therefore, conclude that the accepted standard of 60 c.f.m. per foot of tank perimeter is excessive. It is hoped that additional field and research investigations will be undertaken, by others, to substantiate our findings or to determine this required ventilation rate, and to determine the solvent losses which are added by this rate. It must be remembered that only about 25% of these ventilated tanks were operated under 15 feet per minute and 52% were operated in excess of 25 feet per minute. Therefore, it is felt, that where the operating rate is controlled by a hoist and the tank is well located, a ventilation rate of about 30-40 c.f.m. per square foot of tank area would be sufficient to maintain the solvent exposure of the operator below 100 p.p.m. when ventilation is necessary on the condensing type of machine. Ventilation requirements for the non-condensing machines would probably be greater.

In conclusion, it is felt that ventilation at degreasing tanks is not necessary to maintain an average exposure of 100 p.p.m., if certain precautions of machine operation and location are followed.

These precautions are as follows:

1. Locate machines in rooms as large as possible with good general ventilation but free of sharp air currents over top of tank.
2. Maintain a minimum evaporative area exposed to air.
3. Maintain a minimum freeboard distance of 0.6 the width of the tank.
4. Maintain the heat balance carefully with every change in type and weight of metal.
5. Stack work properly in basket and tank so not to displace vapor in putting work in tank.
6. Prevent dead air space in work.

There is no question of the value of ventilation as a compensator for some poor operating practices. This is demonstrated in Table 10. However, if safe and economical operation is to be secured, ventilation is not the cure-all. Particularly is this important today with present difficulties in securing ventilation equipment. The interest of industrial hygiene is not advanced by controlling a poorly operated process by ventilation, and allowing the continuance of the poor practices that were responsible for the hazardous environmental condition.

TABLE 10.
EFFECT OF VENTILATION

Tank No.	Operating Speed	Atmospheric Solvent Concentration (ppm)	
		Fan On	Fan Off
1	100	76	229
2	20	23	261
3	64	21	119
4	72	61	192
5	48	54	120
6	45	36	335

Summary and Recommendations

THIS investigation consisted of a study of 108 degreasing units of the condensing and non-condensing types, and included 433 atmospheric solvent determinations by means of a new extremely portable micro-furnace. The general average concentrations found, were 96 p.p.m. for the ventilated tank of the condensing type; 135 p.p.m. for the non-ventilated condensing tank, and 221 p.p.m. for the non-ventilated, non-condensing units. Tanks employing both trichloethylene and perchloethylene were included in this study. The importance of maintaining certain operating precautions and good tank location was shown. The greatest detrimental poor operating practice was the excessive operating speed in manually operated tanks. Only 20% of the machines were correctly operated.

It was concluded from this study that tank ventilation is not generally necessary if tanks are carefully operated and well located. However, in some cases ventilation may be necessary, but in these cases it is felt that 30-40 c.f.m. per sq. ft. of tank area are sufficient when provided through two one-inch horizontal slots along the long sides of the tank.

The following recommendations are made as a result of this investigation:

Tank Design

THAT manufacturers of degreasing tanks market these machines equipped with mechanical hoists set at a maximum speed of 20 feet per minute.

2. That tanks be marketed equipped with thermostatic control of the heating and condensing zones, and also that they be equipped with thermostats to control the vapor height and solvent temperature.

Operation and Location

CARE should be exercised to insure complete condensing of vapor on the work before withdrawing.

2. Work should preferably be withdrawn at a rate of 12 f.p.m. or less, but at no time greater than 20 f.p.m.

3. Satisfactory draining of condensed solvent should be allowed before complete removal from tank.

4. The importance of a proper basket or holding device will eliminate much solvent dragout. The basket should be carefully designed to fit the particular type of work.

5. Tanks should be located in as large a space as possible and free from air motion across the top of the tank in excess of 75 f.p.m.

6. Maintain a minimum evaporative area exposed to air.

7. Maintain a minimum freeboard distance of 0.6 the width of the tank.

8. Maintain the heat balance carefully with every change in type and weight of metal.

9. Stack work properly in basket and tank so not to displace vapor in putting work in tank.

10. Prevent dead air spaces in work.

Ventilation

WHERE ventilation is necessary for irregular shaped work, it should be provided at the rate of 30-40 c.f.m. per square foot of tank area through two one-inch horizontal slots extended along the far and leading edges of the tank.

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Lead Hazard

—Occurring During Repair of a Burned Ship—

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RECENTLY there occurred a severe fire on board a large troop transport, and, during the repair, the workmen complained that they were exposed to a considerable amount of irritating dust.

Investigation showed that, as a result of the fire, there was considerable debris lying around in the ship compartments which had to be removed. This debris consisted of:

1. Layers of fiberglas insulation, part of which was still on the partitions and was being ripped down and part of which had been torn down incident to fighting the fire.

2. Ash from the combustion of furniture, hangings, paint, wire, insulation, woodwork, plumbing fixtures, etc.

3. Miscellaneous metal scrap.

This debris was shoveled into piles, loaded into wheelbarrows, carried to dumping platforms inside the ship and thence dumped and shoveled out through port holes. The port holes were connected with chutes and the debris thus dumped on the dock. The location of the ship was such that it was unprotected from the wind and frequent gusts of wind blew debris dust back through the port holes into the ship and swirled it around inside the compartments.

Dust samples of the air were taken with the Greenburg-Smith impinger at the rate of one cubic foot per minute and the particles counted in a Neubauer-Bright Line counting chamber. These samples were taken at the following locations:

1. At the edge of the former dining room midway between the shoveling and dumping operations where the air was relatively quiet and not markedly affected by gusts of wind.

2. At the site where the debris was scraped together into piles and then shoveled into wheelbarrows.

3. On the dumping platform adjacent to the port-holes connected to chutes.

All these samples were taken inside the ship on the port side of "C" deck, frames 108 and 128 and in an area where a considerable number of men were working.

The table gives the results of the dust sampling:

Description of sample	Time of sampling	Vol. of air sampled	Million particles per cu. ft. of air
Quiet air	15 min.	15 cu. ft.	4.2
Shoveling operation	15 min.	15 cu. ft.	14.9
Dumping operation	5 min.	5 cu. ft.	70.0

At this stage of the investigation we recommended that the workmen exposed to this dust wear respirators affording protection against pneumoconiosis-producing

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and nuisance dusts. However, it occurred to us that the intense heat and reactions during and after the fire upon such materials as paint, cables, pipes, plumbing, etc., might have produced dust with a high lead content.

Preliminary lead analyses demonstrated the following:

1. Paint scales were strongly positive for lead using the microscopic technique of Chamot and Mason with the formation of crystals of lead nitrate and lead iodide as the criteria.

2. Debris samples from wheelbarrow loads and the dumping platform were strongly positive for lead using the same technique.

3. Quantitative tests on these same debris samples were done with Fairhall's chromate method and found to contain 9% lead. The moisture content of this debris was 2% and being so small it was disregarded.

However it remained to be shown how much of this lead in the debris dust was suspended in the air, thereby exposing the workmen to a lead hazard. For even though lead might be found in debris dust samples taken from wheelbarrow loads, dumping platforms, etc., it was necessary to determine if such lead particles were sufficiently small to remain suspended in air for a considerable period of time.

Therefore we suspended our original debris samples in a dust chamber and made dust counts and lead analyses of these suspended particles. With the stirring fan running continuously to keep the dust cloud distributed uniformly throughout the dust chamber, a 20-min. dust sample was taken with the impinger. To determine further whether the lead particles settled out slowly or rapidly, a second dust sample was taken immediately after the first, for a period of 36 min. with the fan shut off. In each case the dust particles were counted and lead analyses run on these impinger samples using the diphenylthiocarbazone (dithizone) colorimetric technique. The lead content of the second set was slightly higher than the first set, indicating that the lead particles did not settle out more rapidly but remained suspended longer than the rest of the particles.

Sample	Time of Sampling	Millions of particles per cu. ft.	Micrograms of lead	mgm. lead per 10 cu. meters of air	mgm. lead/10 cu. meters/ million particles/ cu. ft. of air
No. 1 (fan on)	20 min.	49.0	864	15.3	0.31
No. 2 (fan off)	36 min.	8.7	420	4.12	0.47

These lead concentrations were sufficiently close so that an average figure of 0.4 was used and applied to the original dust concentrations obtained on board the transport to determine the lead concentrations to which the workmen were exposed.

Description of sample	Millions of dust particles per cu. ft. air	mgm. lead/ 10 cu. meters/ million particles/ cu. ft.	mgm. lead/ 10 cu. meters of air breathed by workmen
Quiet air	4.2	0.4	1.68
Shovelling operation	14.9	0.4	5.96
Dumping operation	70.0	0.4	28.00

Summary and Recommendations

THESE concentrations are all above the threshold of 1.5 mgm. of lead per cu. meters of air. It is obvious that under these conditions respirators which afford protection against toxic dusts should be used. Accordingly respirators approved for pneumoconiosis-producing and toxic dusts were recommended.

Undoubtedly in the future there will be repairs made to other burned ships. In such cases where facilities are not available for making lead analyses on the dust, it is recommended that the workmen be equipped with the previously mentioned respirators.

This work is being presented in the hope of protecting future workmen against the dangers of lead poisoning, during repair work on board a burned ship.

Acknowledgment is made to CAPTAIN H. E. JENKINS, Medical Officer, Boston Navy Yard, for his cooperation and for affording us the opportunity to pursue this investigation, and to the Liberty Mutual Insurance Company for allowing us the privilege of using their dust chamber.

Effects of War

—On the Scope of Industrial Hygiene—

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SUFFICIENT has been said heretofore of the importance of industrial hygiene in the war effort. It is needless to restate that the "war will be won or lost in the industrial plants of America" and similar familiar slogans. We are in agreement that industrial hygiene contributes freely to the war effort; thus it behooves us as Governmental Industrial Hygienists to supply rapidly the effective tools for health maintenance of the industrial worker and his family.

I will refrain from discussing the augmented health problems confronting industry in war time, a familiar field to all here. Increased industrial hygiene problems, with limited trained personnel, further reduced by entrance of some into industry and others into the armed services, forces us to attempt an answer to this question, "How can we affect war production most favorably with limited personnel and equipment?"

The method of attacking lost time due to sickness and accidents in the State of Washington has caused some little comment. I present herein a limited picture of the industrial hygiene activities there, hoping that we may leave this meeting with the consensus of the conference as to how far a State Industrial Hygiene service should go in connection with general public health activities, without forgetting that industrial hygiene was originally concerned with the control of occupational diseases per se, but has in recent years been thought of in the more general terms of "adult hygiene."

The State of Washington, Department of Health, inaugurated industrial hygiene services in 1936. This activity was discontinued because of a chain of local circumstances which, it appeared, might jeopardize the effective operation of the entire department. The program was recently reactivated, because the State of Washington is now a critical war production area with over 200,000 workers building planes and ships, and another 300,000, and more, in other essential war production.

The new Division of Industrial Hygiene was created in October, 1942, about two and one-half months before the State Legislature convened. The Division was operating largely on the budget of the U. S. Public Health Service, which supplied a physician, engineer and chemist, in addition to essential field and laboratory equipment. Those nearest the local picture felt some state appropriation should be made by the 1943

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legislature. Consequently, activities differing from those usually carried on in a newly created division were inaugurated with the aim of selling industrial hygiene in a short time. However, by the time the legislature convened it was felt inadvisable to request appropriation because the educational program had not progressed sufficiently. The unusual procedure in starting this program resulted in overselling the general public health phases of industrial hygiene leaving little time for activity in environmental control.

Lack of understanding cooperation between the State Department of Health and another state department contributed to the early termination of industrial hygiene in Washington in 1936. Thus the first activity of the new Division was concerned with developing proper relationships between these two departments. A marked degree of coordination of effort has resulted, one indication of which is the fact that copies of all occupational disease reports to that department are now made available to the Department of Health; another, that all preventive phases of occupational diseases will possibly soon be placed in the Department of Health, although the other department is charged by law with compensation for occupational diseases, and has in the past made an effort toward their control.

Another early activity was the establishment of an Industrial Hygiene Advisory Committee to the State Department of Health. It seemed advisable for the purpose of speeding up the effective operation of the industrial hygiene program, to have a group of experienced and responsible men who might advise the Division with regard to its proposals and see that the policies agreed upon were properly presented to the groups they represented. The committee members were appointed by Governor Langlie, who presided at the first meeting, which was held in his office. He instructed the committee as to their duties and explained the need for industrial hygiene services in the State Department of Health in preference to some other state department. He pointed out that this made available to the industrial workers and their families all of the services of the state and local health departments. The membership of the committee includes two past presidents of the State Medical Society, two representatives of labor (one from the C. I. O. and the other from the A. F. L.), two representatives of management, and representatives of the two state departments, Labor and Industries, and Health.

This committee proved to be a keenly interested, working group who met frequently, at times with the Governor and/or other notables such as the Regional Director of the War Manpower Commission, when considering absenteeism reporting. A brief resume of some of the more important activities of the committee follows, stressing those problems which some among us feel are of secondary importance.

FIRST, was the establishment of policies to free the Department of Health from responsibility of adjudicating compensation claims or participating in such judication. (The lack of such understanding was one of the most important reasons for the failure of the industrial hygiene program in 1936.)

Second, a consideration of the advisability of using industrial hygiene as a vehicle to carry public health to workers in industry, instead of limiting the activities primarily to environmental sanitation. The committee's thinking was in line with our convictions, that with limited personnel and no field or laboratory equipment, the need to sell industrial hygiene to the people of Washington rapidly, called for emphasizing that environmental sanitation was but a part of the service which could be brought to the worker through industrial hygiene. It is my belief that industrial hygiene people can well do more about the non-occupational diseases which are responsible for 90% of the time lost due to illness and accidents, bearing in mind that the occupational diseases account for only 3%. The non-occupational disease problem was considered in committee from the standpoint of the responsibilities of labor and management toward recognizing and intelligently attacking the problems of lost time due to the venereal diseases, tuberculosis, faulty nutrition, poor dental health and similar problems. This activity is bearing fruit, as frequently requests for services arise from unexpected places where a committee member has directly or indirectly planted seeds which have already sprouted.

Third, the matter of sick absenteeism reporting which, of course, is closely tied up with the non-occupational disease problem. The advisability of the committee promoting absenteeism reporting within their respective groups has been seriously considered. Study was made of forms used by representative size and types of plants with the view toward recommending a uniform reporting system for all war industries. This activity has been temporarily tabled to consider the fourth and final activity to be discussed which, owing to local circumstances, seemed timely to consider, namely the promotion of interest among labor, management, and the medical profession for preplacement and periodic physical examinations of all essential war workers. I will mention only two reasons for stressing this problem: First, the fact that we are now at the bottom of the labor reservoir which emphasizes the need for putting one-armed men on one-armed jobs, and second, a situation peculiar to the west coast where the Metal Trades Council of the A. F. L. has in all of its labor contracts a clause prohibiting any and all types of physical examinations. This ruling affects all shipyard workers and those of other heavy metal industries of the area.

Permit me to state briefly the methods used by the committee to promote interest in this problem in labor, management, and medical groups. The opinion was that workers with certain physical defects now considered unemployable could be employed to good advantage if placed in a job they were physically fitted to do. Likewise the problem of injuring the health of workers now doing jobs for which they are physically unfit was considered. After thorough exploration by the labor representatives of the committee they reported their belief that the objection to physical examinations might be overcome if labor were given an opportunity to collaborate in planning the industrial health programs. Subsequently, the committee arranged to meet with the state representatives of the two major labor organizations to get their reactions to the problem, and more specifically, their objections. The committee agreed that if this group were willing to sponsor the program with certain reservations, the details would be discussed in a like meeting with representatives of management, and a plan agreeable to all developed after which the medical profession would be called in to assist with the final planning.

Labor's representatives on the committee selected the labor officials from their respective organizations to attend the meeting. Present at the meeting were the Governor, six representatives each of the C. I. O. and A. F. L., and all members of the Industrial Hygiene Advisory Committee. Although the attitude of labor's representatives was encouraging, the go-ahead signal was not sounded. After some delay, awaiting the report of the joint labor committee, the Industrial Hygiene Advisory Committee agreed that further education, particularly of labor, was needed. A statement of policy regarding physical examinations was then drawn up

for widespread distribution throughout the state. It included a recommendation for labor-management committees to consider the problem on an individual plant basis. There has been some activity following this action, although the time is too short to xpress an opinion on the effectiveness of this latter procedure.

Other activities that were carried on simultaneously consisted of the usual routine, such as establishing an office, laboratory, and library, and developing a program of policies and procedures. An educational program consisting of radio, articles for local publication, and talks (including a combined program on industrial hygiene and industrial surgery which was presented to the several medical societies in the more industrialized areas) has progressed rather well.

JUST as other divisions of the State Department of Health promote the application of their programs, in whole or in part, through the local health department, so does the Division of Industrial Hygiene promote such part of its program through the local health department as local units are prepared to handle effectively. Likewise the Division of Industrial Hygiene represents the health department in industrial hygiene as well as in the initial discussions with management, labor, and other groups in matters of health. I feel it essential at this point to express my personal feeling of the importance of making available all health services to the war worker. No longer should the health department use the school as the lone nucleus for promulgation of its activities. Industry also provides an opportunity for health workers to contact large groups of people. Certainly the program in the war plant should be emphasized even should such emphasis detract for the duration from the present importance attributed to school programs and other non-essential war health activities. One health program, for example, which is largely devoted to the school is nutrition. I see no great danger in letting the school nutrition program carry along on its own strength for the present, permitting the people who established this program to develop another for the worker who builds ships and planes.

Another example of how peacetime health services can be modified to meet the war emergency is illustrated by the following public health nursing experience in the State of Washington. In Vancouver, Washington, a critical war area, the local health department is heavily overloaded owing to a great influx of war workers in addition to some loss of personnel. Through cooperation between that health department and the medical department of a large shipbuilding corporation arrangements are now worked out for the health department to provide supervision and assistance to nurses employed by the company for the purpose of supplying nursing srvices, including public health nursing, to their employees and their employees' families. Such a program will of course call for some de-emphasis of non-industrial activities. This close tie up of the local health department and industry provides an opportunity for that health department to show what a local health department can do for industry and for an industrial community. If the venture is successful, I predict the trend will be for industry to help official health agencies and thereby assure their employees of wartime public health services. If the health department makes all of its servics available to industry, thus protecting the workers' health, I am convinced that public health, including industrial hygiene, will not experience a set back in the post-war period. If industrial hygiene is to be a part of a public health program, it must serve as a spear head and vehicle for bringing needed and acceptable public health services into industry. With only two or three people to serve over one-half million essential war workers, I believe their time can best be spent in getting the services of hundreds of health workers to the producer. Industry needs the services of the health department, and the public health movement needs the financial and moral backing of industry and labor.

It is no doubt needless for me to say that I am looking at this picture from the viewpoint of a public health administrator, and am attempting to look at industrial hygiene in a broader light than the highly technical phase. Thus I consider industrial hygiene as an agency that, in addition to supplying an important technical service, introduces management and labor to the other technical services of the health department. Feeling that the latter is an urgent and important function of the Industrial Hygiene Division, I am not too concerned with the mechanics of its application. Formerly, I felt this could best be done by first giving the industrial plant a specific industrial hygiene service, such as eliminating an occupational disease hazard. This has been found to sell management on the health department and open the door for the other services. I am convinced that we should at least be as concerned with the factors responsible for the 90% of lost time as with those responsible for the 3% of lost time. The 3% was formerly attacked chiefly as a means of getting the toe in the door. Currently, I am wondering if the method used in Washington may not give the same entry on a wider front, and in less time, than could be gained by direct individual plant services to a very limited number of plants.

Only when the effectively planned services of the public health physician, dentist, tuberculosis and V. D. control officers, nutritionists, nurses, and sanitary engineers are actually being given industry, can we affect the non-occupational disease problem. These services, modified to meet war time conditions, should be applied in a matter of months, if they are to be effective in helping to win the war. A long range conversion program taking many years is not the answer. It is the responsibility of industrial hygiene people to understand their peculiarly advantageous position which enables them to interpret community public health services to labor and management and to introduce these important services to that large segment of our population so essential to the war effort.

I believe the time spent in carrying the broader public health services to the plants and their workers pays dividends in many ways. Permit me to state examples of speedy results brought about by such activities.

As stated above, little funds were available for industrial hygiene services in Washington. When the need became apparent for an industrial hygiene advisory nurse, one of the most capable people in the Nursing Division of Public Health was selected. This nurse remains on the budget of the Division of Public Health Nursing, with everyone convinced that this is as it should be.

At the present time a concentrated sanitary survey of all essential war industry is being conducted by the Division of Public Health Engineering through contacts and introductory services of the Division of Industrial Hygiene which serves in a liaison capacity between the Division of Public Health Engineering and industry. In the early stages of this activity the personnel of the Industrial Hygiene Division are working with the Division of Public Health Engineering to effect the closest possible cooperation of divisions within the Department of Health.

A final example of the rapid results possible is the experience in a plant in another state engaged in the manufacture of electric insulation used in essential radio equipment. This plant employed over 1,000 people, several hundred of whom operated small bench

machines at which they were seated throughout the shift. Every operator was apparently an able bodied man or woman. Following the suggestion of the industrial hygiene personnel, the company soon decided to employ as many physically handicapped persons as could be obtained, to release a like number of normal workers for whole man jobs as the demands for their services arose. Such cooperation between industry and, in this case, the Crippled Childrens Service of the State Health Department who supplied the handicapped people (formerly non-employed) needs initial guidance by industrial hygiene people. This one activity made possible the use of several hundred handicapped persons. I am convinced that relatively few hours work in this case did more for the war effort, through supplying manpower, than could many a medical and engineering environmental study. If the aim of industrial hygiene is to "keep more men, at more machines, more days, to produce more war goods," the general public health aspects must be more strongly stressed by industrial hygienists.

Finally, in discussing the activities of the Washington program, we must not overlook that environmental studies have been conducted. We realize that this highly specialized service can be given only by the Industrial Hygiene Division and therefore must be carried on simultaneously with the essential public health education program. I will not burden you with the number and type of studies made to date but am frank to admit that we in Washington considered the environmental sanitation phase of the program in of secondary importance. Thus the only physician in the Division has been too much concerned with the general public health activities outlined above to devote a great deal of time to investigation of occupational disease reports, which average 165 a month, or to do plant medical industrial hygiene work, such as studying records, evaluating medical programs, and working in the plant with the engineer and chemist. This has necessitated leaving the environmental sanitation to the latter personnel.

I have discussed briefly the industrial hygiene activities in Washington and am aware that the program has been unbalanced. Part of this was intentional and part was the result of overselling the general public health phase of the program in the early stages and the necessity of keeping ahead of others who might trample us in their efforts to carry the ball we had handed them.

Certain accomplishments indicate that even though unbalanced, the program has been effective. Among the accomplishments are:

1. We have just concluded a 10-week course on Industrial Hygiene for nurses at the University of Washington and are committed to conduct, in cooperation with the University, a two-week intensified course in August.

2. The Chief of the Division has presented the subject to the leading medical societies of the state.

3. The State Director of Health and the Chief of the Industrial Hygiene Division spoke at an annual State-Labor Convention, having ridden in on the coat-tails of a member of the Industrial Hygiene Advisory Committee. This indicates the effectiveness of having labor representation on such a committee.

4. Through these educational activities a widespread interest in industrial hygiene has been aroused throughout the state. This interest has resulted in such a great number of requests from industry for assistance in engineering and medical problems, that it has been physically impossible for our limited staff to more than scratch the surface. Because of this demand for service, a 10-week course on Industrial Hygiene for nurses at the University of Washington and are committed to conduct, in cooperation with the University, a two-week intensified course in August.

5. The Governor, having been kept abreast of our activities as we went along, has recently made available sufficient monies from his Emergency Fund for expansion of the original staff and facilities to more than double, and advised that more would be made available if needed. In discussing the industrial hygiene expansion program in Washington, Governor Langlie said "We have a job to do—let's do it," and added his assurance that the people of the State of Washington would not question the expenditure of funds for this essential activity.

In conclusion permit me to restate a desire for this conference to consider further how far industrial hygiene programs with limited personnel and equipment should deviate from environmental sanitation. My personal views require no restatement except for this thought, that perhaps I have overemphasized the public health phase in order to arouse your thought and discussion.

The effect of war on the scope of industrial hygiene is to place a great responsibility on us as industrial hygiene workers. We must decide how, with existing industrial hygiene facilities, together with our state and local health departments, we can give the most effective service to keep manpower on the production front.

I quote Doctor Warren F. Draper, Assistant to the Surgeon General of the U. S. Public Health Service, who has said, "Perhaps the most far-reaching obligation of the U. S. Public Health Service is to coordinate the health-conservation activities of industry, labor, medicine and interested government agencies."

Discussion

W. E. DOYLE, M.D., (Director, Bureau of Industrial Hygiene, State Department of Health of Kentucky): DR. FARNER has presented an excellent paper on the effects of war on the scope of industrial hygiene, but I am afraid that he is over optimistic that we will leave this meeting with the consensus of the conference as to how far a state industrial hygiene service should go in connection with general public health activities while not forgetting that industrial hygiene originally concerned itself with the control of occupational diseases. I do not believe that any one-day conference of governmental industrial hygienists could formulate a consensus opinion on such a far reaching program of industrial hygiene activities.

There are 38 reasons why we do not all think alike in this connection. By this I mean the 38 individual state industrial hygiene bureaus, each with its geographical considerations, the policies governing the State Departments of Health or Labor under which these Bureaus are organized, the length of time these Bureaus have been functioning and the personnel available to the individual Bureau, as well as the more or less fixed opinions of each of the state directors. I believe that DR. FARNER has attacked the problem presented to him in the state of Washington with a great deal of enthusiasm, careful thought and administrative ability. He has quickly evaluated the needs of his state and has gone about solving the problems with energy and dispatch. As he has told us, the rebirth of the Division of Industrial Hygiene in Washington is very recent, inaugurated with little personnel and even less money, and yet he has had to serve and serve quickly some half million industrial workers in essential war production. He has intimated friction between certain state departments, which obviously had to be smoothed over before any program could be adopted for the advancement of industrial hygiene in his state. The fact that he has received such a degree of success in coordinating his departments in such a short time is a happy indication of the success with which his educational approach is being received.

Another signal success is that he has hope that the preventive phases of occupational diseases will be placed in the Department of Health where they belong.

He has listed for us some activities of his industrial hygiene advisory committee of the State Department of Health, which he says he feels that some of us may con-

sider to be of secondary importance. My personal opinion is that neither one or the other is primary and neither one or the other secondary—that all are of equal importance. To free the Department of Health of the responsibility of adjudicating compensation claims or to participate in litigation is to my mind absolutely essential. We, as industrial hygienists, are fact finders. We should be permitted to present our facts where they will do the most good. We should ride the middle of the road, leaning neither to one side nor the other. If we do this, and do it as a matter of policy, there is absolutely no doubt that we will win, and we will deserve, the faith and cooperation of both labor and management. He considers the advisability of using industrial hygiene as his vehicle to carry public health to workers in industry instead of limiting activities primarily to environmental sanitation. In my opinion, this is right also, particularly where there is limited personnel and but little field or laboratory equipment, but when these limitations are removed and as quickly as they are removed the study of environmental sanitation and immediate direct service to industry should begin. Industrial management wants it, labor wants it. They receive the evaluation that you make of their industrial environments gladly and, nowadays at any rate, they receive your recommendations for control with an open mind and an open purse, and there is no way in which you can make a better friend of industry than in helping them to solve their industrial health problems. I agree with DR. FARNER that industrial hygiene personnel can well occupy itself with non-occupational diseases which, as he says, are responsible for 90% of the time lost due to illness and accidents, and we should bear in mind that occupational diseases account for only 3%. However, there is a considerable amount of industrial ill health which cannot categorically be placed in either occupational or non-occupational diseases. I am referring to the higher morbidity rate among industrial workers than among those non-industrially employed. This we must attribute to the working environment, to the industrial health hazards which may not necessarily be occupational disease hazards. These I feel strongly should deserve our closest scrutiny and study. Among these I might mention fatigue, optimum hours of work, heat and humidity, noise and shock, and mental hygiene.

Medical absenteeism is a problem which is strictly left up to the industrial hygienists to aid in solving. Of course, this is more non-occupational than it is occupational. I have little hope that much can be done in solving the absenteeism problem during this war period. The migrant war worker, the itinerant worker, and the malingerer are playing havoc with the stabilization of labor. The recent War Manpower Stabilization program of the President is doing much to relieve this intolerable situation. The freezing of workers in their present occupation is preventing the tremendous labor turnover which has been a headache to all concerned with absenteeism reporting, recording or evaluating, as well as a headache to the physical examination section of the plant medical departments. In Kentucky we are working in close cooperation with the War Manpower Commission through its U. S. Employment Service. Any worker who presents himself to this bureau for release giving as a reason ill health resulting from occupational exposure is referred to our bureau where a history and physical examination is done and recommendations returned to the War Manpower Commission. In the six weeks that we have been doing this chore, and a chore I assure you it is, I would guess that less than 20% of of those examined have honest and logical reasons for being granted release and for seeking new employment.

DR. FARNER has a particularly difficult situation when a large union or group of unions has labor contracts with a prohibiting clause on all types of physical examinations. However, I am sure that he will overcome this difficulty through his very effective educational approach to labor, management and medical groups. Labor is not nearly as reluctant to study and understand public health as it was a few years ago. Not very long ago, all of the coal mines in Eastern Kentucky had such prohibitive clauses in their labor contracts. Very few of them have today and those are only the very small ones.

I agree with DR. FARNER that the State Health Departments should not use the school as a lone nucleus for public health activities. Certainly industry is just as important, perhaps more so, for obvious reasons. If the industrial worker, who is usually the head of the family, understands and practices public health he carries it to his home and to his children. As DR. FARNER has stated, we have always been concerned as to how to get the toe in the door of industry to open it for our service, whether to use the public health educational method or the immediate specific industrial hygiene service. I say let's get both toes in the door and give them both.

Symposium on Industrial Hygiene

—American Chemical Society, Division of Water, Sewage, and Sanitation Chemistry, Pittsburgh, September 6-10, 1943: Abstracts of Papers—

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DEVELOPMENT AND SCOPE OF INDUSTRIAL HYGIENE SERVICES—R. T. PAGE, State Relations Section, Division of Industrial Hygiene, National Institute of Health, Bethesda, Maryland.

This paper traces the development of industrial hygiene activities particularly in the United States, and outline the objectives and present trends of these activities.

The development of the industrial hygiene program in this country has followed critical events in the history of this Nation. It was initiated in World War I. The second upsurge resulted from the demand for social security as a consequence of the depression which began in 1929. Today its progress is being given further impetus by the war and by the realization that healthy, efficient workers are absolutely necessary for the production of the vital materials for war.

Besides the several agencies in the Federal government which are concerned with industrial hygiene there are industrial hygiene services in practically every industrial state in the Union. Today there are 47 industrial hygiene units in 38 states, one territory, and the T.V.A.

The physicians' studies of the health of workers and the engineers' evaluation of the working environment necessitate numerous laboratory examinations of a clinical, physical, and chemical nature. These call for highly trained chemists and biochemists. Today, with the added use of chemicals in many of our processes, there is a greater need for data concerning the toxic effects of these substances.

Cook

CHEMICAL CONTROL OF INDUSTRIAL HEALTH HAZARDS — WARREN A. COOK, Division of Industrial Hygiene and Engineering Research, Zurich Insurance Companies, Chicago.

The chemist should interest himself to a greater extent in industrial hygiene especially with reference to chemical phases of control of industrial health hazards. This paper outlines a procedure to guide the chemist in his introduction to this activity.

As the chemist is in a strategic position to know all the materials being employed and those contemplated for use in his plant, and since his training permits a ready comprehension of their relative toxicity, he is a logical person to maintain a list of materials used or produced, classified by department and degree of hazard. The purchasing agent should send him a copy of all new materials ordered and the production engineer should notify him of any change in operations which might alter the exposure of the workers to potentially hazardous materials.

In the chemical control of health hazards, the chemist should keep a record of the extent of all exposures. Some will be manifestly low, others obviously in need of control, but many are on the borderline where actual determinations are necessary to decide whether they are safe or hazardous. These exposures should be determined either by air analysis, by some indication of the amounts actually absorbed as through analysis of urine, or by a combination of both such methods. Examples are given of the relative value and role of these several types of methods for evaluation of exposures.

Reference is made to the availability of industrial hygiene services to assist the chemist in undertaking this work.

These findings should be interpreted by the chemist on the basis of toxicological data and referred with his interpretations to the plant manager and to the medical department. Where engineering control measures have been instituted, check determinations should be made to evaluate their efficacy.

Discussion is included concerning the value of routine quantitative data on the exposure to potential health hazards in the establishment of toxic limits based on actual industrial conditions. It is pointed out that the chemist should accept his part in the responsibility for good industrial hygiene and should undertake much of the actual work of chemical control of industrial health hazards.

Holden and Hemeon

THE HYGIENIC APPRAISAL OF SOLVENT VAPORS AND THEIR CONTROL BY VENTILATION—FRANCIS R. HOLDEN, and W. C. L. HEMEON, Industrial Hygiene Foundation, Pittsburgh.

One result of the spreading war industries has been the extension of the use of toxic solvents. The conversion of small peacetime factories to war production has produced widespread exposure to chemicals not previously handled. Industries which manufacture metal parts for war machines are using degreasing solvents, often for the first time. They are also introduced in paints, enamel, and lacquers, the majority of which are applied by spray guns. Rubber cements, some containing harmful solvents, also are used extensively. These are but a few of the exposures encountered.

Experience gathered over the years by our basic industries has made the safe control of solvent vapors readily possible. However, the specialized knowledge of the relative danger from benzol or butyl acetate, from toluol or carbon bisulfide, and the varying degrees of control necessary for their safe usage, are not always possessed by many of the new manufacturers of war equipment.

Chemists are likely to be easy prey to the fallacy in ventilation that vapors of solvents are heavier than air and therefore exhaust applied near the floor or at a low point is a panacea for control of noxious vapors. It is shown that the idea is false and the reasons therefor. For ventilation purposes, the specific gravity of a solvent vapor relative to air is not the ratio of its molecular weight to that of air, as is so commonly assumed.

Watrous

BENZOL POISONING—PROGRAM FOR ITS CONTROL IN LIGHT CHEMICAL PLANT—R. M. WATROUS, M.D., Abbott Laboratories, North Chicago, Illinois.

Benzol is an important industrial poison, especially in the light chemical industry, because of its wide use as a solvent, its unsuspected occurrence in many mixed solvents and other products of unstated composition, and the insidious nature of its toxic effect. Chronic poisoning may take place under conditions of exposure not generally recognized as dangerous, and the damage to the bone marrow may be irreversible, causing death. The "safe" upper limit in the workroom air was formerly considered as 100 to 50 p.p.m., but modern studies question whether any concentration is safe for certain sensitive persons.

Exposure to benzol may be measured by analysis of air samples or by testing the conjugated urinary sulfates in those exposed, but neither method indicates whether damage is being done to the workmen. The only way to detect early damage is by medical examination, and the most important feature of this is the periodic blood count. Some statistical considerations necessary for determining the "normal" blood count are discussed. Bearing normal variations in mind, it is possible to classify blood counts as "normal," "suspicious," or "seriously abnormal" in chemical workmen. An arbitrary standard for accomplishing this is presented.

Using this standard, periodic blood counts have been made for over three years in a light chemical industry where there is considerable exposure to benzol which cannot be eliminated. An average working force of 100 has thus been scrutinized. A method is described whereby all the blood counts of 100 or more men can be shown graphically on a single sheet, enabling the medical administrator to survey the entire benzol control problem at a glance. This method has satisfactorily detected several cases of incipient poisoning, prompting remedial measures which prevented any serious outcome.

Goldman

METHODS OF SAMPLING AND ANALYSIS OF AIR CONTAMINANTS IN THE WAR INDUSTRIES—F. H. GOLDMAN, National Institute of Health, Bethesda, Maryland.

The manufacture of munitions and other war materiel has given great impetus to industrial hygiene activities in an effort to control the health hazards of the industrial environment. Due to dangers from fire and explosion many of the usual methods of sampling have had to be discarded and new ones substituted.

The power-driven large impinger is replaced by the midget impinger. Various types of midget bubblers have been designed. Gases and vapors have been trapped in such bubblers by filling them with special reagents and liquids. These bubblers are usually operated at a rate of 1 to 3 liters per minute for 10 minutes. Nitro compounds such as tetryl and TNT, metal fumes, chlorinated hydrocarbons, and alkaline earth dusts have been sampled in this manner. The analytical procedures used for the determination of ammonium picrate, dinitrotoluene, tetryl, TNT, nitroglycerine, PETN, mercury fulminate, and chlorinated hydrocarbons are mentioned and described briefly.

New apparatus for collecting "grab" samples is described including special bottles for nitrogen oxides and benzol as well as a mercury seal flask for solvent vapors.

Special instruments such as the "mercury detector" and the "benzol indicator" are calibrated in terms of the various organic solvent vapors for which these instruments are also used.

The techniques of emission and absorption spectrography as well as polarography and x-ray diffraction photography have also been applied in this field.

Kehoe, Cholak, Largent

THE HYGIENIC SIGNIFICANCE OF THE CONTAMINATION OF WATER WITH CERTAIN MINERAL CONSTITUENTS—R. A. KEHOE, M.D., J. CHOLAK, and E. J. LARGENT, Kettering Laboratory of Applied Physiology, College of Medicine, University of Cincinnati, Cincinnati, Ohio.

The usual means and the extent of the contamination of drinking water with lead, zinc, copper, aluminum, tin, silver, manganese, and fluorine, as shown by the available information, are briefly discussed. The importance of the additional intake of these elements in foods and other beverages, in relation to the problem of safe concentrations in water, is pointed out. The physiological behavior of certain of the trace elements, with respect to their absorption, distribution, and fate in the human body is outlined, and some of the problems yet to be investigated are defined.

Lea

RAPID INDIRECT DETERMINATION OF ZINC BY THE DITHIZONE METHOD—WILLIAM L. LEA, Industrial Hygiene Division, Wisconsin State Board of Health, Madison, Wisconsin.

Zinc may be determined in the presence of lead by first determining the lead content of an aliquot of the sample by the usual dithizone technique. On a second aliquot the zinc and lead are simultaneously extracted as dithizone compounds by omitting the potassium cyanide from the aqueous extracting solution. The chloroform solutions of the extracted lead and zinc dithizone compounds are washed free of excess uncombined dithizone with a dilute ammonium hydroxide solution and subsequently decomposed by washing with a 1% by weight solution of hydrochloric acid. The chloroform layer containing the free dithizone obtained by the acid decomposition of the lead and zinc dithizone compounds is reconverted to lead dithizone by shaking with an aqueous solution of pH 9.0 containing excess lead. The chloroform solution of lead dithizone thus formed is drawn off and compared with lead standards. The lead content of the sample, as previously determined, is subtracted from the new lead content based upon both lead and zinc, the zinc being expressed or read as lead. The value obtained by difference between these two concentration values is divided by 3.17, the ratio of the atomic weights of lead and zinc, to obtain the zinc concentration of the sample being analyzed.

In making lead determinations by

visual color matching, it is customary to match the color of the lead dithizone compound obtained from an aliquot of the sample with standards prepared in a similar manner. Since the lead dithizone compound is not stable over long periods of time, it is necessary to prepare fresh standards for each set of samples. This time consuming disadvantage in visual color matching is overcome by the preparation of synthetic color standards which are stable over a long period of time.

American Industrial Hygiene Association
News of Local Sections

Metropolitan New York Section

A REVIEW of the Industrial Hygiene Symposium held by the Division of Water, Sewage and Sanitation Chemistry of the American Chemical Society at the Pittsburgh, Pennsylvania meeting on September 6, 1943, it being presented by F. A. Patty, L. Scheflan and M. B. Jacobs at the first meeting, on September 29, 1943.

Of much interest to members of the Section as well as other members of the Association throughout the country is a mimeographed description of some of the chemical methods employed in the Laboratory of the Division of Industrial Hygiene of the New York State Department of Labor. Dr. Leonard Greenburg, Executive Director, states that this manual which is essentially a reprint of a previous issue is available without charge to interested persons.

Chicago Section

THE first of eight meetings which are planned for the Chicago Section was held on September 30, 1943. Following the programs of previous years, a number of subjects or phases of a subject are being covered in a single evening in order to include the interests of the diversified membership of the Section. MR. JAMES R. ALLAN, International Harvester Corporation, and Member of the Advisory Committee to the Illinois Industrial Commission, is to discuss the Proposed Industrial Sanitation Code for the State of Illinois. This subject which will be open for an informal discussion by the members will be followed by a sound strip film entitled "Welders—To Your Health," recently released by the U. S. Maritime Commission and the U. S. Navy. LIEUTENANT KENNETH W. NELSON, USNR, who is in charge of industrial hygiene for the shipyards in the Great Lakes Area under the direction of PHILIP DRINKER, Chief Health Consultant of the U. S. Maritime Commission, is making this picture available and will also present the first scientific data developed on the factors of time and distance necessary to cause eye-flash from the welding arc. This research was conducted by DRINKER, Past President of the Association.

Michigan Section

THE Michigan Industrial Hygiene Society is to schedule a number of meetings during the coming year outside of Detroit in such cities as Grand Rapids, Lansing and Flint, so that there may be a more extensive participation in the activities of the Section.

A major contribution of the Michigan Society is the instigation of the "In-service Training Course in Industrial Hygiene for Plant Safety Personnel" which has been planned as the result of a request of the Society to the Dean of the School of Public Health, University of Michigan. Nine of the 10 members of the Planning Committee are members of the Society. The Program of the course which is being given October 19-21, 1943, by the University at Ann Arbor is as follows:

Tuesday, October 19

MR. H. G. DYKTOR—Course Leader, presiding:

"Orientation"—HENRY F. VAUGHAN, DR. P.H., Dean, School of Public Health, University of Michigan.

"The Significance of Industrial Hygiene"—C. D. SELBY, M.D., Medical Consultant, General Motors Corporation.

"The Relationship of the Safety Engineer to Industrial Hygiene"—O. F. LEHMAN, Safety Engineer, Chrysler Corporation.

"Environmental Aspects of Industrial Hygiene"—R. R. SAYERS, U. S. Public Health Service.

"Control of Solvent Vapors and Acid Mists"—W. G. FREDERICK, SC.D., Chief Chemist, Bureau of Industrial Hygiene, Detroit Department of Health.

"Control of Smokes, Fumes, and Gases"—H. H. SCHRENK, PH.D., Chief Chemist, Health and Safety Division, U. S. Bureau of Mines.

"Evaluation and Control of Dust"—J. J. BLOOMFIELD, Senior Sanitary Engineer, Division of Industrial Hygiene, U. S. Public Health Service.

Colored Motion Picture and Discussion—Safe Operation of Solvent Degreasers, prepared especially for this school.

Study of Educational Exhibits—Supervised by Contributors.

Group Discussion Topics—MR. BLOOMFIELD, Discussion Leader.

1. Foundry and Forging Practices: moulding, core making, shake-out, cleaning, heat treating, etc.

2. Metal Finishing: machining, grinding, welding, plating, metal cleaning and painting, etc.

3. Plastics: formaldehyde resins, impregnation, curing, fabrication, etc.

Wednesday, October 20

MR. T. F. MOONEY—Course Leader, presiding:

"Industrial Ventilation Practices"—W. N. WITHERIDGE, Director, Bureau of Industrial Hygiene, Detroit Department of Health.

"Applications and Limitations of Respiratory Protective Equipment"—DR. SCHRENK.

"Personal Protective Clothing and Equipment"—J. A. PURDY, Director of Safety, Michigan Mutual Liability Company.

"Causative Agents of Industrial Dermatitis"—LOUIS SCHWARTZ, Medical Director, U. S. Public Health Service.

"Dermatitis Preventive Measures"—DR. SCHWARTZ.

"Modelling of Women's Protective Clothing."

Topic: Legal Interpretation of the Recent Modifications of the Michigan Workmen's Compensation Act. Presiding: JOHN W. GIBSON, under whose administration as Chairman, Michigan Department of Labor and Industry, this act was revised.

Speaker: L. J. CAREY, General Counsel, Michigan Mutual Liability Company.

Discussants: THEODORE RYAN, Counsel, Michigan Department of Labor and Industry; JOHN LOVETT, General Manager, Michigan Manufacturers Association.

Thursday, October 21

MR. W. N. WITHERIDGE—Course Leader, presiding:

"Plant Sanitation"—H. G. DYKTOR, Chief Engineer, Bureau of Industrial Hygiene, Michigan Department of Health.

"Maintenance and Its Relation to Safety and Health"—W. L. LOVETT, Safety Director, N. A. Woodworth Co.

"How to Make a Survey for Health Hazards"—A. C. FUNKE, Industrial Hygienist, Michigan Mutual Liability Co.

"How to Sell Industrial Hygiene to the Worker"—JOHN W. GIBSON.

"How to Utilize the Resources of Official and Private Industrial Hygiene Agencies"—K. E. MARKUSON, M.D., Director, Bureau of Industrial Hygiene, Michigan Department of Health.

Summarization—H. E. MILLER, Public Health Engineering Division, School of Public Health, University of Michigan.

The officers of the Michigan Section for the year 1943-44 are as follows:

President: H. G. DYKTOR,, Chief Engineer, Bureau of Industrial Hygiene, Michigan Department of Health, Lansing; President-Elect: A. L. BROOKS, M.D., Medical Director, Fisher Body Division, General Motors Corporation, Detroit; Past President: S. F. MEEK, M.D., Assistant Medical Director, Chrysler Corporation, Detroit; Secretary-Treasurer: W. N. WITHERIDGE, Director, Bureau of Industrial Hygiene, Department of Health, Detroit.

The Executive Committee is comprised of G. C. HARROLD, PH.D., Industrial Hygienist, Chrysler Corporation, Detroit; T. F. MOONEY, Industrial Hygienist, Ford Motor Company, Dearborn; A. O. THALACKER, General Manager, Detrex Corporation, Detroit; MARY ALTON, R.N., Industrial Nursing Consultant, Bureau of Public Health Nursing, Michigan Department of Health, Lansing; F. J. JARZYNKA, M.D., Medical Director, Bohn Aluminum & Brass Corporation, Detroit, and K. B. HUTCHINSON, Safety Engineer, Zurich Insurance Company.

Industrial Hygiene

THIS section has been established to study and help in the control of those conditions in industry which may injure the health of workers. Its services include: (1) Medical studies, in cooperation with private or industrial physicians, of workers who are thought to be suffering from sickness as a result of exposure to processes or materials used in manufacturing. (2) Examination of air in industrial plants to determine the concentration of harmful dusts, gases, vapors, fumes, mists or sprays present in the atmosphere of workrooms. (3) Recommendation of methods for the control of industrial health hazards. (4) Investigation of new industrial processes and materials to determine what their effect will be on health. (5) Aid in establishing adequate industrial medical services which are of benefit both to the worker and to the industry. (6) Assistance in making the facilities of the State Health Department available to every employed person.

—From "Functions and Services of the Louisiana State Board of Health." in *New Orleans M. & S. J.*, September.